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SHORT COMMUNICATION

DISPERSAL OF *STEGODYPHUS DUMICOLA* (ARANEAE, ERESIDAE): THEY DO BALLOON AFTER ALL!

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ABSTRACT. There has been some controversy about whether adult females of social *Stegodyphus* disperse by ballooning. Here we show that adult *Stegodyphus dumicola* (Eresidae) Pocock 1898 are able to gain up-lift by releasing a very large number of threads. The threads fan out widely from the spider's body and form a triangular sheet. This previously unknown ballooning mechanism, enables even large spiders to disperse over large distances.

Keywords: Eresidae, *Stegodyphus*, dispersal, ballooning, social spider

Dispersal by ballooning appears to be restricted to very small spiders and is mainly a strategy of juvenile spiders that disperse shortly after their emergence from the eggsacs (Decae 1987; Foelix 1996). The probability of ballooning as a function of spider size quickly approaches zero when the body mass exceeds 1 mg. Suter (1999) stated that large spiders are unlikely to balloon because thermal and climatic conditions are rarely favorable. In addition, unpredictable patch quality and low survival probability of ballooning spiders should make this strategy unattractive for adult spiders.

Wickler & Seibt (1986), however, observed a single adult *Stegodyphus mimosarum* (Eresidae) Pavesi 1883 ballooning; and Crouch et al. (1998) reported that during a mass dispersal event, adults of *S. mimosarum* became airborne and were carried for several meters by strong, gusting winds. In the latter case, it is not clear if the spiders ballooned, i.e., if they lifted off the surface by means of silk, or if they were blown horizontally and used the silk to anchor themselves. *Stegodyphus mimosarum* is one of three social species of the genus and is distributed throughout southern Africa. Social *Stegodyphus* Simon 1873 are characterized by dispersal of adult females that usually have a body mass larger than 100 mg. Wickler & Seibt (1986) described the single ballooning individual as flying with 3–4 silk strands that were no longer than 3–4 m in a barely perceptible breeze. Henschel et al. (1995) used these figures in Suter's (1991) formula and concluded that with the given length of silk and the described wind velocity, an adult spider of that size (80–150 mg) could not become airborne. The apparent contradiction can have two possible causes: either the observation was misinterpreted or the parameters used in the formula did not exactly describe the observed situation. Recent observations now enable us to clarify the issue.

Between 25–31 January 2000 we checked 31 colonies of *Stegodyphus dumicola* Pocock 1898 on a daily basis. (Voucher specimen are deposited at the National Museum in Windhoek, Namibia.) The nests were evenly distributed in an area of approximately 70,000 m^2 (7 ha). The study site was on the farm Omdraai, located 100 km southeast of Windhoek, Namibia. The days were hot (28–33 °C), and there was almost no wind. On such days, rising thermals occur characteristically during the warm, calm hours of the day. On 27 January, around noon, 20 females of one colony were seen "tiptoeing" on the highest strand of the web. Tiptoeing behavior occurs as a prelude to ballooning: the spider stands on raised legs with the abdomen pointed upwards at an angle to the prosoma. In this position, silk released from the spinnerets will rise even in an almost imperceptible breeze (Foelix 1996). We observed these females releasing silk, and some became airborne. However, silk became snagged on nearby bushes so that the spiders landed between 1–8 m away from their nest of origin. During the late afternoon of the following day the same behavior was observed in three other nests. On one occasion, more than six spiders in quick succession were lifted almost straight up and could be observed gaining height for a few sec. We lost sight of the spiders after they reached a height of approximately 30 m. These spiders were the size of adult females, between 7–14 mm body length (see Kraus & Kraus 1988).

Perhaps the most important aspect of our observation is that the spiders used a very large number of silk strands to become airborne. At least tens to hundreds of threads were seen silhouetted against the sky. The threads fanned out widely from the spider's body and formed a triangular sheet with a length and width of about 1 m at its distal end. The silk that was released was not combed, appeared to be produced quickly, and did not tangle or clump once released.

In the 31 nests observed, females in 10 colonies were observed tiptoeing as spiders prepared to release silk threads. In two colonies we saw bridging, a common method of dispersal in *Stegodyphus* (Henschel et al. 1995); and in one colony we saw ballooning. We measured the sizes of all nests by using the two largest diagonals. Ten nests that produced dispersers were significantly larger ($n = 10$; mean ± SE = 155.2 ± 20.23 mm^2) than nests without dispersers ($n = 21$; mean ± SE = 60.5 ± 9.26 mm^2; Kruskal-Wallis test: $Z = 3.61$, $P < 0.0003$). As nest size is related to colony size (Henschel 1998), this indicates that only larger colonies produced dispersing females.

In order to assess the reproductive status of dispersing individuals, nine females were collected while tiptoeing, which is indicative of imminent dispersal, and were kept in the laboratory without access to males. Seven of these females produced eggsacs within 6 wk after collection. This indicates that most, if not all dispersers are potentially capable of founding new colonies after establishing a new nest at their destination.

We did not observe males dispersing. Interestingly, 10 out of 17 collected colonies showed an unusual sex ratio of 25–52% males. *Stegodyphus* colonies usually have female-biased sex ratios (14–21.2% males) and the sex-ratio bias is primary (Avilés et al. 1999). Thus, the most likely explanation for the reduction in bias is that the majority of the females had left the colony whereas the males did not disperse.

Ballooning on multiple strands is a dispersal mechanism in spiders that has never been described before. By using multiple strands even large adult spiders may be able to disperse over great distances and to colonize new habitats. This has to be taken into consideration in the future when investigating population genetics and structure in the social *Stegodyphus*.

There are a number of questions that remain open. Which glands produce the ballooning silk? The large number of threads would suggest that cribellate silk might be used; but if so, it is apparently not combed out. What keeps the multiple threads from collapsing or coalescing? Perhaps electrostatic forces play a role in keeping the threads apart. Is the lift generated by such a large number of threads equal to the sum of the forces acting on each one, or do the threads indeed form a sheet dense enough to be considered as a whole? Finally, is ballooning the regular dispersal mode used by social *Stegodyphus*? Colonies appear to send out dispersers only in one particular state of development, namely after the majority of females have matured and mated and before egg-laying begins (Henschel et al. 1995; Henschel 1998). Thus, for dispersal by ballooning, weather conditions must be suitable during a rather narrow time window. Long-term monitoring of dispersal and climate will be required to answer this question.

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